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## **SHOULD FOREIGN AID FINANCE PRIVATE OR PUBLIC INVESTMENT?**

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### **Abstract**

The paper examines from the welfare point of view whether it is better to give aid for private or public investment. Recently there has been discussion in bilateral and multilateral aid agencies on whether foreign development assistance should be directed to private instead of public sector investment projects in order to promote welfare in the recipient countries and to accelerate their move towards self-reliance. It has been argued that public sector projects are less productive than private ones and, therefore, to raise the standards of living in the country, aid should be given to finance private sector activities.

Using a two-country overlapping generations framework the paper shows that categorical recommendations to give aid to finance only private investment or only public investment are likely to be misguided. The appropriate allocation of aid varies from country to country depending on the structure of the economy, in particular on the initial stock of private and public capital and on how investment projects affect the productivity of private capital and labor. Thus, depending on the circumstances, aid to finance either private or public investment may enrich the recipient country. Specifically, the paper shows that aid to finance public investment benefits the recipient country if its initial stock of public infrastructure capital is small and aid is given to social infrastructure projects like education and health care that raise the productivity of labor.

## 1. INTRODUCTION

*"Since private economic activities might normally be expected to qualify for commercial financing, there is some presumption that foreign aid might have a comparative advantage in financing government expenditures, and especially investment."*

*Krueger (1986, p. 68)*

*"It tends to be assumed by some aid critics that, if a relatively small share of aid is directed to final uses in the private sector and a larger one to final uses in the public sector, the aid inflow must be damaging to the interests of the private sector. ... Some aid agencies--perhaps most notably those of the USA and West Germany--are keen to see a higher proportion of aid directed to the private sector."*

*Cassen and Associates (1994, p.193 and p.199)*

A major part of worldwide foreign development assistance goes to finance government projects in developing countries. Recently, however, there has been discussion in bilateral and multilateral aid agencies on whether foreign development assistance should be directed to private instead of public sector investment projects in order to promote welfare in recipient countries and to accelerate their move towards self-reliance. It has been argued that public sector projects are less productive than private ones and, therefore, to raise the standards of living in the country, aid should be given to finance private sector activities. Further, it has been argued that foreign

aid to the public sector, unlike aid to the private sector, increases the patronage and power of the recipient government which leads to increased bureaucracy and reduced efficiency in the economy.

It is surprising that despite the importance of the decision regarding the allocation of foreign aid, the existing development literature does not seem to have examined which is better from the welfare point of view: to give aid for public or private investment. To be sure, there is extensive literature on the role of aid in economic development, summarized, for example, in Riddell (1987), Krueger and Michalopoulos and Ruttan (1989), and Cassen (1994). In particular, there are several studies of the transfer problem including papers by Leontief (1936), Samuelson (1947), Chichilnisky (1980), Brecher and Bhagwati (1981,1982), Yano (1983), Bhagwati, Brecher and Hatta (1985), Kemp and Kojima (1985), Galor and Polemarchakis (1987), Haaparanta (1989), and Schweinberger (1990).<sup>1</sup> However, all these papers assume that a transfer is given to the private sector to augment consumption, whereas in practice aid is given to the public sector or to the private sector to finance investment.

The purpose of this paper is to examine from the welfare point of view whether it is better to give aid for private than for public investment. The analysis is carried out in a two-country overlapping generations model. A two-country model is needed to capture the effects of financing aid. Using an overlapping generations framework in turn allows us to explore the intergenerational impact of aid. The key

assumption in the model is that government investment in infrastructure increases the productivity of private capital and labor. This assumption is supported by the empirical findings of Aschaeur (1989a,b) and Barro (1989).

This study shows that under certain circumstances it is optimal to give aid in the traditional way, namely to public investment. Instead of weakening the private sector in the recipient country, investment in public infrastructure may bring direct benefits to both the public and private sectors. In particular, it is shown that aid to finance public investment may benefit the recipient country more than aid to private investment if the infrastructure in the country is deficient and aid is given to social infrastructure projects like education and health care that raise the marginal productivity of labor. Aid to those kinds of public investment activities raises wage income and savings in the recipient country without necessarily pushing up the interest rate and debt service payments. As a consequence, private investment is crowded in and welfare and consumption rise over time. It is also shown that there is a trade-off between the welfare of the current and future generations when aid goes to finance private investment. While aid to finance private investment increases the welfare of future generations, it immiserizes the currently working generation by lowering the interest rate and discouraging savings.

Following the introduction, the paper proceeds as follows. The model is developed in section 2. The intertemporal welfare effects of aid are derived in section

3 and analyzed in section 4. The final section contains a few concluding remarks.

## 2. THE MODEL

The analysis is carried out in an expanded version of the Persson (1985) two-country overlapping generations framework. The two countries are referred to as an LDC and a DC, the LDC being a transfer recipient and the DC a donor. The DC variables are marked by a superscript asterisk.

All individuals live for two periods. So, at each point in time there are two generations alive: the young, who work, and the old, who are retired. For simplicity, it is assumed that the size of the labor force is equal in the LDC and DC and that it grows at a common rate  $n > 0$ . Labor is assumed to be immobile between countries, whereas the mobility of private capital is assumed to be perfect.<sup>2</sup> This implies that the interest rate is equal in both countries.

The government in each country is assumed to be benevolent, maximizing the welfare of the representative generation. It provides public investment services  $g$  ( $g^*$ ) for consumers and private producers without employing a user fee. Instead, it finances its spending and interest payments on its debt by imposing lump sum taxes or by issuing new public debt.

Following Aschauer and Greenwood (1985) and Barro (1990), public investment spending  $g$  ( $g^*$ ) is assumed to be productive. Public services are assumed to be rival and excludable so that each individual is interested in the per capita, not aggregate, quantity of them.<sup>3</sup> Examples of these kind of public investment services are education, health care, water and sewer, and to some extent highways and electricity. A rise in public investment is assumed to contribute, with a lag of one period, to the government's per capita capital stock  $x$  ( $x^*$ ), which depreciates fully in one period in both countries:<sup>4</sup>

$$(1) \quad (1+n)x_{t+1} = g_t$$

$$(2) \quad (1+n)x^*_{t+1} = g^*.$$

The DC government is assumed to make in period  $t$  a transfer of income  $e_t$  either to the LDC government to finance public investment ( $e^g_t$ ), or to the private sector in the LDC to finance private investment ( $e^i_t$ ).<sup>5</sup> The transfer is an outright grant.<sup>6</sup> For simplicity, the DC government is assumed to finance it by raising taxes. The DC government is also assumed to hold public investment spending ( $g^*$ ) constant at its optimal pre-transfer level. To keep the analysis tractable it is further assumed that both the LDC and the DC government balance the budget by adjusting lump sum taxes  $\tau_t$  ( $\tau^*$ ) while holding the stock of domestic public debt per worker  $b$  ( $b^*$ )



constant. Hence, the DC government budget constraint is as follows:

$$(3) \quad \tau_t^* = (r_t - n)b^* + g^* + e_t^g + e_t^i.$$

The DC government makes the transfer contingent upon the LDC's fiscal policy. Aid is given for public investment projects on the condition that the LDC government holds its own public investment spending constant at its initial, pre-transfer level.<sup>7</sup> The LDC government thus faces two constraints:

$$(4) \quad \begin{aligned} \tau_t &= (r_t - n)b + g \\ g_t &= g + e_t^g. \end{aligned}$$

It is assumed that governments in both countries are able to commit their successors to these specific fiscal policies.

After the transfer is made, the young in both countries decide how they allocate their wage income between current and future consumption and firms determine their investment in private capital. Firms in both countries act competitively, employing labor and capital, which depreciates fully in one period, for the production of consumption goods. In addition to private inputs, the public capital stock is assumed to enter into the firms' production functions (in per worker terms). For simplicity,

production functions are assumed to be identical in the LDC and DC:

$$(5) \quad y_t = f(k_t, x_t)$$

$$(6) \quad y_t^* = f(k_t^*, x_t^*).$$

Production is assumed to exhibit constant returns to scale over the two private inputs, K and L ( $K^*$  and  $L^*$ ), but increasing returns to scale over all three inputs, K, L, and X ( $K^*$ ,  $L^*$ ,  $X^*$ ). Further, the firms' output is assumed to be an increasing and concave function in both k and x, and to satisfy Inada conditions. The assumption that production exhibits increasing returns to scale over all three inputs is consistent with Aschauer's (1989a,b) empirical findings, according to which there is a positive correlation between the stock of public capital--particularly public infrastructure capital of streets, sewers and mass transit--and private sector productivity in the United States. Barro (1989) obtained analogous results using a sample of several countries. The endogenous growth literature also emphasizes the role of public infrastructure capital as an engine of growth.<sup>8</sup>

Since factor markets are competitive and the government provides investment services without charging a user fee, private factors are paid according to their productivity. Hence, the wage rate (w) in the LDC is

$$(7) \quad w_t = f(k_t, x_t) - k_t r_t.$$

The demand for capital goods per worker is obtained by equating the marginal productivity of private capital with the rate of interest, which gives  $k_{t+1} = k(r_{t+1}, x_{t+1})$ ,  $k_r < 0$ ,  $k_x > 0$ . It is further assumed that  $f_{kx} > 0$  and  $(f_x - k f_{kx}) > 0$ , that is, a rise in the public capital stock will raise the marginal productivities of both private inputs.<sup>9</sup>

Similar relations hold for the DC.

All young people are endowed with one unit of labor. They work during the period they were born, for which they receive a net-of-tax wage income. Given the interest rate ( $r_{t+1}$ ) they allocate this income between current and future consumption to maximize utility over their life cycle. The decision problem of the young born in period  $t$  in the LDC is thus as follows:

$$(8) \quad \begin{aligned} & \text{Max} \quad u(c_1^t, c_2^t) \\ & (c_1^t, c_2^t) \geq 0 \\ & \text{s.t.} \quad w_t - \tau_t = c_1^t + \frac{c_2^t}{(1+r_{t+1})}, \end{aligned}$$

where the first and second period consumption  $c_1^t$  and  $c_2^t$ , respectively, are assumed to be gross substitutes and normal. Optimal consumption choices give the indirect utility function  $V_t = V(1+r_{t+1}, w_t - \tau_t)$ . Similar relations hold for the DC.

Old people are retired. They consume all their income, which consists of principal and interest on their savings invested in physical capital ( $k$ ) and government bonds ( $b$ ) as young. In addition to savings, private investment in the LDC can be financed by borrowing abroad ( $h$ ) and with the transfer ( $e_t^i$ ) from the DC. Since all the forms of investment are regarded as perfect substitutes and capital is perfectly mobile between countries, equilibrium in the LDC and DC asset markets, respectively, requires

$$(9) \quad (1+n)(k_{t+1}+b-h_{t+1}) = s(1+r_{t+1}, w_t-\tau_t) + e_t^i$$

$$(10) \quad (1+n)(k_{t+1}^*+b^*-h_{t+1}^*) = s^*(1+r_{t+1}, w_t^*-\tau_t^*),$$

where  $s(1+r_{t+1}, w_t-\tau_t) = \arg \max \{u[w_t-\tau_t-s_t, (1+r_{t+1})s_t]\}$  is the saving function of an individual in the LDC. Since private consumption in both periods is assumed to be normal, a propensity to save out of an additional unit of wage income is positive  $s_w, s_w^* \in (0,1)$ . The assumption that first and second period consumption are gross substitutes in turn implies that  $s_r, s_r^* > 0$ . The country that has a higher saving propensity is assumed to lend to the other one. It is assumed that the saving propensity in the DC is larger than in the LDC,  $s_w^* > s_w$ , so that the DC is a creditor and the LDC is a debtor, that is,  $h > 0$  and  $h^* < 0$ .<sup>10</sup>

Since the world as a whole is a closed economy, in the world capital market

equilibrium private international debt cancels out. Because the two countries are of equal size, the world asset market equilibrium condition is  $h_{t+1} + h_{t+1}^* = 0$ , or that world savings equal world investment:

$$(11) \quad (1+n)(k_{t+1} + k_{t+1}^* + b + b^*) = s_t + s_t^* + e_t^i.$$

The world interest rate  $r_{t+1}$  adjusts to satisfy this condition.

Equations (1)-(11) form a model which is used next to examine the intertemporal welfare effects of a permanent transfer  $e_t = e_{t+i} = e > 0$ ,  $i=1,2,\dots$ , from the DC government to the LDC to finance either public or private investment.<sup>11</sup>

### 3. THE INTERTEMPORAL WELFARE EFFECTS OF AID

A transfer of income given to finance either private or public investment in period  $t$  affects the welfare of the currently young and future generations. It has no impact on the welfare of the currently old, because their consumption is determined by their savings which were determined in period  $t-1$ .

The change in the welfare of the currently young in the LDC and DC, respectively, can be solved from the indirect utility function using Roy's Identity

$$V_r = V_w s / (1+r):$$

$$(12) \quad dV_t = V_r dr_{t+1}$$

$$(13) \quad dV_t^* = V_w^* \left[ \frac{s_t^*}{(1+r_{t+1})} dr_{t+1} - de_t^g - de_t^i \right].$$

Equation (12) indicates that the transfer affects the welfare of the currently young in the LDC only indirectly through a change in the interest rate. A rise (fall) in the interest rate promotes (reduces) their welfare because it increases (decreases) the return to their savings and hence their old age consumption. The absence of direct effects is explained by the earlier made assumption that an increase in investment contributes to the capital stock only with a lag. Since the transfer is financed by imposing taxes on the currently young in the DC, the transfer has, in addition to the interest rate effect, a direct negative impact on welfare in the DC, as equation (13) shows.

The effect of a transfer on the short run interest rate can be solved from equation (11), using the LDC and DC government budget constraints (3) and (4):

$$(14) \quad \left[ (s_r + s_r^*) - (1+n)(f_{kk}^{-1} + f_{k^*k^*}^{-1}) \right] dr_{t+1} = s_w^* (de_t^g + de_t^i) + f_{kx}^{-1} de_t^g - de_t^i.$$

(+)
(+)
(+)
(-)

The impact on the interest rate can be divided into three parts. The first term on the right hand side of equation (14) represents the "finance effect" of a transfer on the interest rate, and it is positive. Since the transfer is financed by taxes, the net-of-tax

wage income of the currently young in the DC decreases. Total world savings go down because income is transferred from a high saving country to a low saving country. This reduction in the supply of capital pushes the interest rate up. The second and third terms on the right hand side represent the disbursement effect. That effect is positive when the transfer finances public investment ( $e^g$ ) since by the earlier made assumptions an increase in the public capital stock will raise the marginal productivity of private capital ( $f_{kx} > 0$ ). However, if the transfer finances private investment ( $e^i$ ), the supply of private capital increases and the disbursement effect on the interest rate is negative.

The long run steady state welfare effects of a transfer in the LDC and DC are as follows:

$$(15) \quad dV = V_w \left[ \underbrace{\left( \frac{s}{(1+r)} - k - b \right)}_{(+/-)} dr + \underbrace{\frac{f_x}{(1+n)} de^g}_{(+)} \right]$$

$$(16) \quad dV^* = V_w^* \left[ \underbrace{\left( \frac{s^*}{(1+r)} - k^* - b^* \right)}_{(+/-)} dr - de^g - de^i \right],$$

(-)    (-)

Equations (15) and (16) reveal that the impact on long-run welfare depends not only on the interest rate effect but also on the signs of  $[s/(1+r)-k-b]$  and  $[s^*/(1+r)-k^*-b^*]$ . Whether these terms are positive or negative depends on the difference between the interest rate  $r$  and the growth rate  $n$ , since by equations (9) and (10)  $[s/(1+n)-k-b] < 0$

and  $[s^*/(1+n)-k^*-b^*] > 0$  as by assumption  $h > 0$  and  $h^* < 0$ . If the interest rate is higher than or equal to the growth rate,  $(s/(1+r)-k-b)$  is negative and  $(s^*/(1+r)-k^*-b^*)$  is positive. The interest rate being higher than or equal to the growth rate implies that the initial stock of private capital is small and therefore to finance its investment the LDC has accumulated a large stock of foreign debt. However, if the interest rate is smaller than the growth rate, then both  $(s/(1+r)-k-b)$  and  $(s^*/(1+r)-k^*-b^*)$  may be positive.<sup>12</sup> In that case, the initial stock of private capital is large in the LDC and the stock of foreign debt is small since income and savings are high enough to finance investments.

The steady state change in the world interest rate is

$$\begin{aligned}
 (17) \quad & \left[ (1+n)(f_{kk}^{-1} + f_{k^*k^*}^{-1}) - (s_r + s_r^*) + s_w(k+b) + s_w^*(k^*+b^*) \right] dr = \\
 & \quad (-) \\
 & -s_w^*(de^g + de^i) + \left[ \frac{s_w f_x}{(1+n)} - f_{kx}^{-1} \right] de^g + de^i, \\
 & \quad (-) \quad \quad (+/-) \quad \quad (+)
 \end{aligned}$$

where  $[(1+n)(f_{kk}^{-1} + f_{k^*k^*}^{-1}) - (s_r + s_r^*) + s_w(k+b) + s_w^*(k^*+b^*)] < 0$  by the stability condition.<sup>13</sup>

The long run finance and disbursement effects of a transfer on the interest rate are of the same sign as those in the short run, except that the disbursement effect is a priori ambiguous when the transfer is used for public investment.



The short-run and long-run welfare effects of a transfer to finance public ( $de^g > 0, de^i = 0$ ) or private investment ( $de^i > 0, de^g = 0$ ) can now easily be obtained from equations (12)-(17). The qualitative effects of these transfers are shown in Table 1 and discussed in the next section.

#### 4. AID TO PRIVATE OR PUBLIC INVESTMENT?

Should the DC government give aid to finance private or public investment if it wants to raise welfare in the LDC? This section shows that, depending on the circumstances, a transfer to finance either private or public investment may enrich the LDC. Specifically, the analysis yields four results: first, a transfer to finance public investment raises the welfare of the currently young generation more than a transfer to finance private investment. Second, a transfer to finance private investment benefits future generations if the initial stock of private capital is "small". Third, a transfer to finance public investment enriches future generations if the initial stock of public capital is "small" in the LDC and the transfer is used for projects that raise the productivity of labor. Finally, a transfer to finance public investment may raise the welfare of future generations more than a transfer to private investment. How these results are established is discussed next.

The first result can be seen directly from Table 1: a transfer to finance public investment ( $de_t^g > 0$ ) in the LDC improves the welfare of the currently young

generation unambiguously in the LDC and possibly also in the DC, whereas using the transfer to finance private investment ( $de_t^i > 0$ ) would impoverish the young in both countries. This outcome is easy to explain. If the transfer is used for public investment, the welfare of the currently young increases in the LDC because the interest rate rises and the young are net savers. The interest rate increases because (by earlier made assumptions) an increase in the public capital stock raises the productivity of private capital and thereby the interest rate. In addition, a reduction in world savings due to a transfer pushes the interest rate up. Since the productivity of private capital has risen, the increase in the interest rate does not deter private investment. The welfare of the young in the DC may also rise because the increase in their old age incomes will compensate at least partly for the decline in their current incomes as taxes increase to finance the transfer.<sup>14</sup> If the transfer goes to finance private investment, however, the welfare of the young in both countries goes down. This happens because the increase in the supply of private capital lowers the interest rate, discouraging savings and thereby reducing the old age income of the currently young.

All the long run welfare effects of transfers--that is, the impact on future generations--in Table 1 are a priori ambiguous. Hence, neither a transfer to finance private investment nor a transfer to finance public investment necessarily raises welfare permanently in the LDC. To obtain conditions under which the transfer increases welfare in the LDC, special cases are analyzed. The key variables are the size of the initial capital stock (public and private) and the impact of augmenting

public capital on the marginal productivities of private inputs. It is assumed in equations (15)-(17) that the initial stocks of private and public capital are alternatively "large" or "small", and that an increase in the public capital stock raises either the marginal productivity of private capital or labor. The public capital stock is defined as "large" when  $f_x - kf_{kx}, f_{kx} \approx 0$ ; that is, when a further rise in it has no or little effect on the marginal productivity of private inputs. Similarly, the public capital stock is defined as "small" when  $f_x - kf_{kx}, f_{kx} > 0$ . The stock of private capital is taken to be "large" ("small") when the interest rate  $r$  is lower (higher) than the growth rate  $n$ . Further, as a special case, an increase in the public capital stock is assumed either to raise the marginal productivity of private capital and not at all the marginal productivity of labor, that is,  $f_{kx} > 0, f_x - kf_{kx} = 0$ , or to enhance the marginal productivity of labor and not at all the marginal productivity of private capital, that is,  $f_x - kf_{kx} > 0, f_{kx} = 0$ .<sup>15</sup> The remainder of this section discusses the results obtained in the above-mentioned special cases. It is first explored under what conditions a transfer to finance private investment increases the welfare of future generations. After that the conditions under which a transfer to finance public investment is welfare enhancing are derived.

Analyzing equation (15) in the above-mentioned special cases when the transfer goes to finance private investment gives the second result: a transfer used for private investment ( $de^i > 0$ ) increases the welfare of future generations in the LDC, unless the initial stock of private capital in the LDC is "large". This can be seen from equation

(15) which is rewritten with the help of equation (17) as follows:

$$(18) \quad \frac{dV}{de^t} = \frac{V_w}{A} \left( \frac{s}{1+r} - k - b \right) (1 - s_w^*) \lesseqgtr 0.$$

(-)      (+/-)      (+)

The right hand side of equation (18) is positive if  $[s/(1+r)-k-b] < 0$ . As discussed in the previous section,  $[s/(1+r)-k-b]$  is negative as long as the interest rate  $r$  is higher than or equal to the growth rate  $n$ . The interest rate equals or exceeds the growth rate when the initial stock of private capital is "small". Under these circumstances, a transfer that increases the stock of private capital and thereby lowers the interest rate raises investment, production, and wage income and reduces debt service payments in the LDC. As a result, welfare in the LDC increases. However, if the initial stock of private capital is "large" so that the growth rate is higher than the interest rate, a transfer for private investment decreases welfare over time. In that case a further reduction in the interest rate only discourages savings without encouraging new investment in private capital.

Assuming in equation (15) that the transfer goes to finance public investment yields the third result: if the initial stocks of public and private capital are "small" in the LDC, a transfer to finance public investment projects that raise the marginal productivity of labor increases the welfare of future generations in the LDC, whereas a transfer for activities that raise the marginal productivity of private capital decreases

it.<sup>16</sup> This can be seen by rewriting equation (15) with the help of equation (17) as follows:

$$(19) \quad \frac{dV}{de^g} = V_w \left[ \frac{1}{A} \left( \frac{s}{(1+r)} - k - b \right) \left( \frac{s_w f_x}{(1+n)} - f_{kx}^{-1} - s_w^* \right) + \frac{f_x}{(1+n)} \right] \lesseqgtr 0,$$

(-)          (+/-)          (+/-)          (+)

$$\text{where } A = (1+n)(f_{kk}^{-1} + f_{k^*k^*}^{-1}) - (s_r + s_r^*) + s_w(k+b) + s_w^*(k^*+b^*) < 0.$$

The signs of  $[s/(1+r)-k-b]$  and  $[s_w f_x/(1+n)-f_{kx}^{-1}-s_w^*]$  and thereby the sign of the right hand side of equation (19) are a priori ambiguous. As already discussed,  $[s/(1+r)-k-b] < 0$  if the initial stock of private capital is "small". Whether  $[s_w f_x/(1+n)-f_{kx}^{-1}-s_w^*]$  is positive or negative depends first of all on the size of the initial stock of public capital in the LDC. If the stock is "large", then  $[s_w f_x/(1+n)-f_{kx}^{-1}-s_w^*] < 0$ . However, if the stock is "small", then the sign of the term depends on whether the public investment project raises the marginal productivity of private capital or labor. If it raises the productivity of private capital and not at all the productivity of labor, then  $f_{kx} > 0$ ,  $f_x - k f_{kx} = 0$ , and the term in brackets is negative in sign. If it raises the marginal productivity of labor but not the marginal productivity of private capital, then  $f_x - k f_{kx} > 0$ ,  $f_{kx} = 0$  and the term in brackets is likely to be positive. Putting these pieces together gives the third result.

The intuition behind this result is simple: first, using the transfer for activities that enhance the marginal productivity of labor raises net-of-tax wage income and thus

aggregate demand and saving, but not the interest rate. Since the interest rate does not increase, private investment is crowded in, which leads to an increased stock of private capital and welfare over time. By contrast, using the transfer for public investment activities that raise the marginal productivity of private capital increases the interest rate. This encourages savings, but that effect is outweighed by an increase in foreign debt service payments.<sup>17</sup> As a consequence, private investment is crowded out and labor income and welfare decrease over time. Only if the initial stock of private capital is "large" and the stock of foreign debt is small in the LDC, a rise in foreign debt service payments does not override the positive effects of aid.

Under what circumstances are these conditions for a transfer to public investment to be welfare enhancing likely to be satisfied? That is, when is the initial stock of public capital likely to be "small" and when is a rise in the public capital stock likely to raise the marginal productivity of labor? If the recipient country has a low per capita output and aid is given to finance social infrastructure projects like schooling and health care, the conditions are likely to be satisfied and the transfer to be welfare enhancing. This implication is noteworthy because a significant portion of aid to LDCs is concentrated on physical infrastructure, and the share of investment in human capital and social infrastructure has declined since 1980s (Krueger, Michalopoulos and Ruttan, 1989). The result is established as follows. First, assuming all countries have identical production technologies and public capital enters the production function as an input, it could be argued that countries with a low per

capita output, that is, developing countries, have not accumulated much public capital. Second, public investment is likely to affect both private capital and labor, and it is hard to distinguish which one of the private inputs benefits most. However, if the DC government wants to increase the marginal productivity of labor in the LDC, it may consider giving aid to educational and health care projects. Construction of bridges, highways, and power plants are in turn examples of public investment projects which are likely to raise the marginal productivity of private capital.

Equation (19) also indicates that if the initial stock of public capital in the LDC is "large", and financing public investment has crowded out private investment and kept the LDC's initial stock of private capital "small", a transfer to finance public investment projects reduces the welfare of future generations in the LDC. A transfer, even a pure grant, impoverishes the LDC because by reducing world savings it pushes the interest rate up discouraging private investment. As a result, wage income and welfare fall. Only if the initial stock of private capital in the LDC is "large", may a transfer for public investment be welfare enhancing. This case, however, is not very plausible since had the LDC accumulated large stocks of private and public capital it would be an unlikely aid recipient.

Finally, should foreign aid finance private or public investment? The analysis indicates that if the objective of aid is to raise the welfare of the currently young generation in the LDC, the transfer should be used to finance public investment

projects. It was shown that a transfer to finance private investment, while enriching future generations, immiserizes the currently young one. If the aim of aid, however, is the promotion of long run welfare and economic development in the LDC, the answer depends on the structure of the economy. It was shown that if the initial stocks of private and public capital are "small" in the LDC, both a transfer to finance public and private investment enrich future generations in the LDC. Which one increases welfare most? Comparing equations (18) and (19) reveals the fourth and final result: if the initial stock of public capital in the LDC is "small", a transfer to finance public investment projects that increases the productivity of labor may raise welfare more than a transfer to finance private investment.

## 5. CONCLUDING REMARKS

This paper examined the welfare effects of foreign aid in the donor country and the recipient country over time when aid is given to finance either public or private investment. The analysis provided several interesting insights into the effects of aid.

The most general result of the paper is that categorical recommendations to give aid to finance only private investment or only public investment are likely to be misguided. The appropriate allocation of aid varies from country to country depending on the structure of the economy, in particular on the initial stocks of private and public capital and on how investment projects affect the productivity of private capital



and labor. Thus, depending on the circumstances, aid to finance either private or public investment may enrich the recipient country. Specifically, it was shown that aid to finance public investment benefits the recipient country if its initial stock of public infrastructure capital is small and aid is given to projects that raise the productivity of labor. Aid to finance private investment was shown to raise welfare in the recipient country as long as the initial stock of private capital is small in the country.

While this relatively simple model proved useful in analyzing the impact of foreign aid, in future it would be interesting to remove some of the most obvious limitations of the framework. First, in order to keep the analysis tractable issues related to governance and bureaucracy were omitted: the government was assumed to be benevolent, all public spending was assumed to be productive, and both the public and private sectors were assumed to operate efficiently. Second, the analysis did not address the problem of the fungibility of aid money. These would be fruitful areas for further research.

### Endnotes

1. As early as in the mid 1930s, Leontief (1936) noticed that if the recipient's marginal propensity to consume importables is high, a transfer given to the private sector as a lump sum addition to household income can have paradoxical effects by enriching the donor and impoverishing the recipient due to a change in the terms of trade. Later Samuelson (1947) observed that the paradox can occur in the Leontief's model only if the equilibrium is unstable. In the early 1980s Chichilnisky (1980) and independently Brecher and Bhagwati (1981) and Yano (1983) demonstrated that when there are three countries, the paradox can also occur at a stable equilibrium. Brecher and Bhagwati (1982), Bhagwati, Brecher and Hatta (1985), Kemp and Kojima (1985), and Schweinberger (1990) in turn showed in a two-country framework that aid to the private sector may have paradoxical welfare effects consistent with stability owing to distortions created by policies or aid itself, for example through procurement tying. Recent contributions to the literature--and closest to the present paper--are by Galor and Polemarchakis (1987) and Haaparanta (1989), who study intertemporal effects of transfers in a two country overlapping generations model. Galor and Polemarchakis demonstrate that when there is no public debt, a permanent transfer to the private sector can have paradoxical welfare effects only if the equilibrium is inefficient. Haaparanta (1989) shows that a transfer paradox may arise even in an efficient equilibrium if there is public debt and the transfer is temporary.
2. Official development assistance is merely complementing, not substituting, private lending (World Development Report for 1985). Private banks are reluctant to lend for long-term development projects, like creating school and health care systems or building sewerage, from which benefits are not immediately appropriable.
3. The assumption of rivalry and excludability of public services could easily be replaced by the assumption of non-rivalry and non-excludability without changing the main results of the paper.
4. The variables without a subscript  $t$  are time independent.
5. Alternatively, the DC government could give a transfer to the private sector as a lump sum addition to its income or to the LDC government to be used for public consumption. It could easily be shown that these transfers would have same qualitative welfare effects.
6. According to the Development Assistance Committee aid qualifies as official development assistance if (i) it is undertaken by official agencies, (ii) its aim is to promote welfare and economic development by raising investment and future

consumption, and (iii) it has minimum grant element of 25 percent (Cassen and Associates 1988, p.2).

7. This assumption abstracts from the problem of the fungibility of aid. However, this simplifying assumption can be justified by the fact that recently an increasing part of aid flows has been made conditional on economic policies of the recipient country, and one typical condition is a ceiling on public spending. On conditionality and foreign aid see, for example, Mosley, Harrigan and Toye (1991).

8. See, for example, Blejer and Khan (1984), Matsuyama (1989), Murphy, Shleifer and Vishny (1989), Barro (1990) and Brock (1990), and Krueger and Orsmond (1990).

9. A subscript on a function denotes a partial derivative with respect to that argument.

10. Another way to explain why the other country is a creditor or a debtor is to assume, as in Buiter (1981), that countries differ in their pure rate of time preference.

11. It could easily be shown that the results obtained in this paper also hold for a temporary transfer:  $e_i > 0$ ,  $e_{t+1} = 0$ ,  $i=1,2,\dots$

12. The LDC government budget constraint,  $\tau_t = (r_t - n)b + g$ , implies that taxes can be positive both when  $n > r$  and  $r > n$ . However, if  $n > r$ , there is an upper bound for  $n$ ,  $n^{\text{upper}} = r + g/b$ , beyond which taxes become negative. A similar relation holds for the DC government.

13. Assuming the government both in the LDC and DC balances the budget by taxes and holds national debt per worker constant, so that  $\tau_{t+i} = (r_{t+i} - n)b + g$  and  $\tau_{t+i}^* = (r_{t+i}^* - n)b^* + g^*$ ,  $i=1,2,\dots$ , the world economy will asymptotically converge to a unique steady state if

$$0 < \frac{dr_{t+1}}{dr_t} < \frac{-[s_w(k_t + b) + s_w^*(k_t^* + b^*)]}{[(1+n)(f_{kk}^{-1} + f_{k^*k^*}^{-1}) - (s_r + s_r^*)]} < 1.$$

This condition is satisfied if both countries are stable in autarky, that is,  $(1+n)f_{kk}^{-1} - s_r + s_w(k_t + b) < 0$  and  $(1+n)f_{k^*k^*}^{-1} - s_r^* + s_w^*(k_t^* + b^*) < 0$ .

14. It could easily be shown that if the DC government financed the transfer by issuing domestic debt instead of raising taxes, it would unambiguously benefit the young in the DC. The reason for this is simple: if the transfer is financed by debt, the future generations, not the current one, in the DC are paying for it. Thus, the young benefit from the transfer at the expense of future generations. These effects are equivalent to the intergenerational welfare effects caused by changes in public debt, which were studied by Persson (1985).

15. The assumption that an increase in the public capital stock affects only the marginal productivity of private capital or labor, though unnecessary restrictive for the analysis, helps in the exposition of results.

16. The result that a transfer given to finance public investment may have paradoxical welfare effects by impoverishing the recipient and--as it could easily be shown--enriching the donor is interesting also in view of the previous literature on the transfer problem. In the previous literature it has been shown that a transfer to the private sector as a lump sum addition to the household's income may affect welfare paradoxically when, for example, there are three agents (Gale (1974), Yano (1983)) or in the presence of distortions (Bhagwati, Brecher and Hatta (1985)). Here it is shown that a transfer to the public sector to finance public investment may also have perverse impact on welfare.

17. How plausible is it that savings in the LDC and total world savings increase as a result of a transfer? A number of econometric studies have attempted to estimate the effects of aid on the recipient country saving rates. The evidence obtained in these studies is, however, mixed. Griffin and Enos (1970), Chenery and Syrquin (1975) and Weisskopf (1972), for example, present evidence that aid reduces savings in the recipient country, while different, less negative, results are reported in Gupta (1970), Papanek (1972) and Mosley (1982). In addition, none of these studies examine the effects of aid on the donor country saving rate. Hence, what happens to total savings is an open question.

TABLE 1. The Effects of Transfers

	Transfer to Public Investment	Transfer to Private Investment
$r_{t+1}$	+	-
$V_t$	+	-
$V_t^*$	?	-
$r$	?	-
$V$	?	?
$V^*$	?	?

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